DIALOGUE ON CLIMATE, WATER, ENERGY AND HUMAN SECURITY IN AFRICA

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The Africa Center for Security Studies, US Africa Command, and the US Army Corps of Engineers seek to connect security and stability to resiliency in preventing, mitigating and responding to climate, environmental and human threats in Africa. Key objectives for an expert community, which will convene in Stellenbosch, South Africa over 27-29 May, 2014, include the identification of threat 'hotspots, to identify various methodologies for achieving more resilient and robust solutions in addressing these threats, to identify various gaps in institutional capacities and implementation capabilities for organizations responsible for managing water resources in these basins/regions on a transboundry basis, and to launch more robust co-operation among and between the African natural resource and security communities. To this end, this dialogue will be launched, highly focused and resolute, to explore these links in four (4) key African regions: Lake Chad, the Nile river basin (including the equatorial lakes), the Congo river basin, and the Lake Victoria Basin. Acknowledged is the fact that both the threat landscape and the challenges to security and stability in the identified African focal regions are multi-dimensional and therefore hybrid in nature. In addition, the environmental threats vary in frequency, intensity, and even spatially within a given region let alone from region to region (or basin to basin). What follows is a sample of some key issue areas, broken down by region, that will be addressed during the workshop proceedings. The intent of the following, brief summaries, is to catalyze creative and pragmatic thinking for driving forward judicious solutions in a comprehensive fashion based on multiple assessments of threats and challenges prosecuted on a case study basis.

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NOTE ON APPROACH

Development projects in the water domain, designed to serve human development and security purposes, are more often than not referenced, referred to or defined in terms of the water basin itself. It is important to point out that water resources, directly or indirectly, serve regions as well. A regional perspective versus a basin specific (riparian) perspective is therefore more encompassing and therefore can be more inclusive in terms of identifying political, economic, and governance issues external to the basin but that have impact on water access, water availability and water quality within the basin itself. By way of example, where climate change may a broad regional impact, well beyond the narrower basin framework itself, in assessing the impact of these changes identifying and to the extent possible measuring the regional implications of these changes do have impact. Depending on the environmental nature of these changes (drought, floods, sea level rise, eco-system impact on vegetation, etc.) human populations will move in, out or through a basin. Populations may migrate over territorial boundaries, effectively resettling in another country, in search of the preservation of livelihoods. Itinerate herders of livestock in search of pasture-lands or water are a good example of this phenomenon. In the summaries that follow, for organizational purposes each geography is defined by its basin orientation. However, as stated impacts that are changing dynamics within the basin may be of a regional nature, i.e. ex-riparian, and should be seriously considered in assessing the impact on water from non-traditional factors within the basin itself.

Climate Change in the Region

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change projected changes in relation to major climate phenomena (IPCC, 2013[i]). For the Africa region, the changes include enhanced summer monsoon precipitation in West Africa, increased short rain in East Africa, and increased rainfall extremes of landfall cyclones on the east coast (IPCC, 2013, p106). The predictions are based on Representative Concentration Pathways (RCP) scenarios. RCP4.5 is a conservative stabilization scenario, a mitigation scenario and scenario with significantly higher emissions.

The projected changes in temperature (50% percentile) are shown in Figure 1, which indicates an increase of 2-3^{o}C in average temperature across most of the region for both summer and winter periods. The influence of the ocean mass on the coastal areas can be seen, with slightly lower increases in average temperatures.

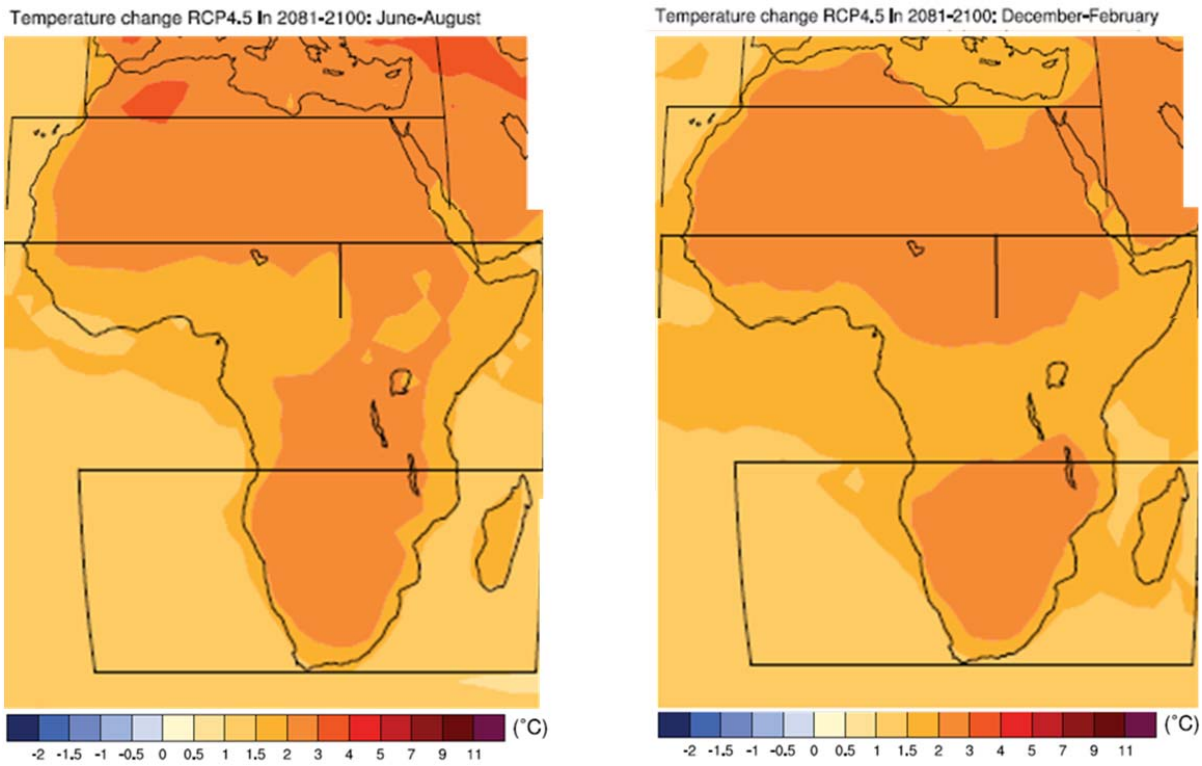

Figure 1: Predictions of temperature change for the RCP4.5 scenario over Africa (50% percentile) for 2081-2100 (adapted from IPCC, 2013).

The predicted changes in precipitation (Figure 2) show a decrease of 0-20% for North Africa in summer and winter. Sub-Sahara Africa is expected to have increased rainfall (0-20%) for East and West Africa in October to March (the dry season), whereas the rainy season (April to September) shows increases of 0-10% in rainfall, with a 0-10% decrease in rainfall expected for the Horn of Africa and the extreme West.

Southern Africa is expected to have generally lower rainfall in the rainy season (October-March) – ecept for the extreme South-East, where a slight inrease is expected. Precipitation for the dry season (April-September) is expected to be generally lower (0-30%).

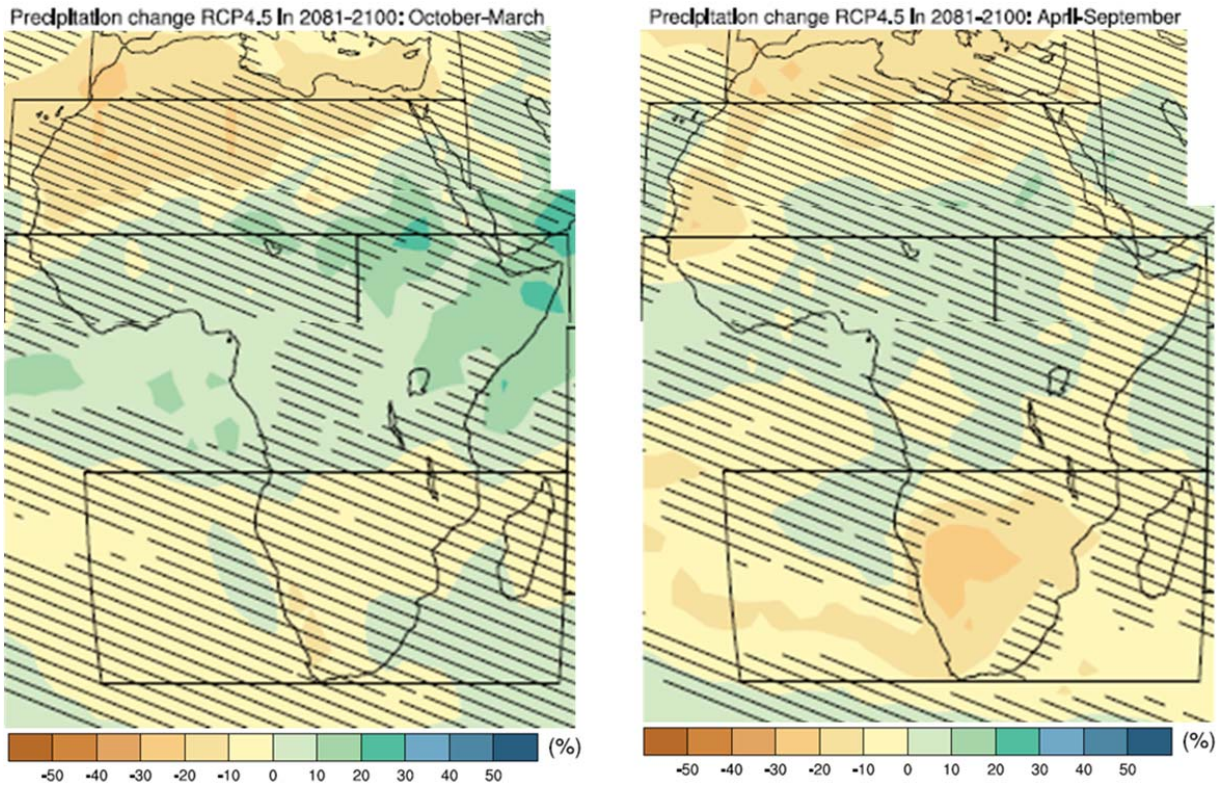

Figure 2: Predictions of precipitation change for the RCP4.5 scenario over Africa (50% percentile) for 2081-2100 (adapted from IPCC, 2013a).

The IPPC report on impacts, adaptation and vulnerability[ii] summarised the impacts of climate change on elements of human security and the interactions between livelihoods, conflict, culture, and migration. The summary (Figure 3) shows how interventions and policies can change initial conditions (black dots), leading to spcific outcomes (white dots), with some interventions showing net increase human security (blue arrows) while others lead to net decrease in human security (red arrows). The report (IPCC 2013b) further provide examples of important risks that climate change pose to human security (Table 1). Each risk levels are estimated for the near-term and for the longer-term era of climate options and for the current state of adaptation and for a highly adapted state.

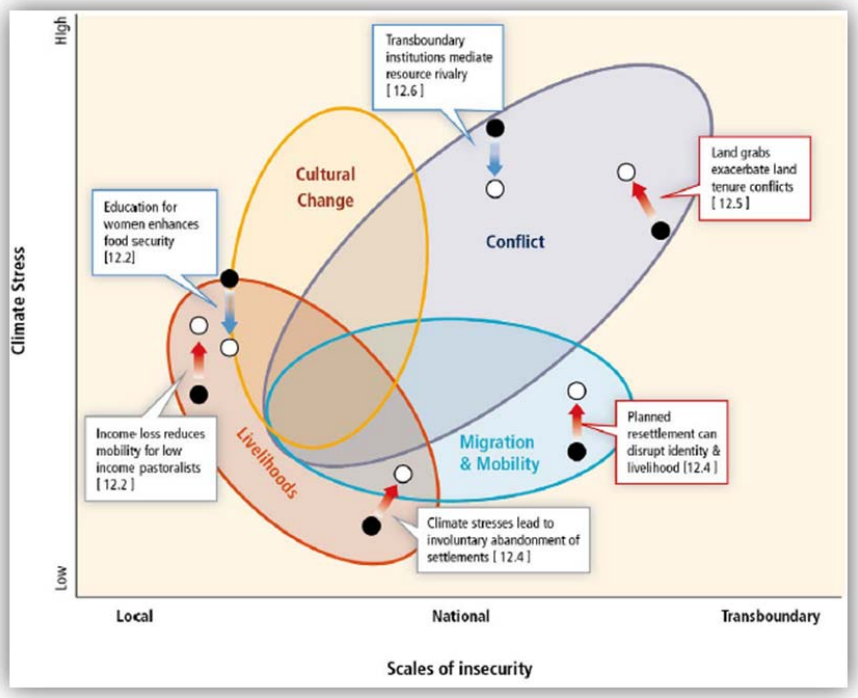

Figure 3: Summary of the impacts of climate change on elements of human security and the interactions between livelihoods, conflict, culture, and migration (IPCC 2013b)

Table 1: Examples of risks posed by climate change to elements of human security and the potential for risk reduction through mitigation and adaptation (IPCC 2013b).

Key risk	Adaptation issues and prospects	Climatic drivers	Supporting ch. sections	Timeframe	Risk for current and high adaptation
Shifts in biome distribution, and severe impacts on wildlife due to diseases and species extinction (*high confidence*)	Very few adaptation options; migration corridors; protected areas; better management of natural resources		22.3.2.1, 22.3.2.3	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low – Medium – Very high
Stress on water resources currently facing significant strain from overexploitation and degradation, and increased future demand, will be compounded by temperature rise and changes in precipitation (*high confidence*)	Reducing nonclimate stressors on water resources is critical for realizing adaptation co-benefits. Strengthening institutional capacities for demand management, groundwater assessment, integrated water-wastewater planning and integrated land and water governance would advance adaptation planning.		22.3.2.2, 22.3.3, 22.4.2, 22.4.4, 22.4.5	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low – Medium – Very high
Degradation of coral reefs results in loss of protective ecosystems and fishery stocks (*medium confidence*)	Few adaptation options; marine protected areas; conservation and protection; better management of natural resources.		22.3.2.3	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low – Medium – Very high
Reduced crop productivity with strong adverse effects on regional, national and household food security, linked to temperature rise and precipitation changes, and secondary (indirect) impacts, such as those linked to increased pest and disease damage and flood risks to food system infrastructure (*high confidence*)	Adaptation can be made more effective where technologic adaptation responses (e.g. stress tolerant crop varieties, irrigation, etc.) are embedded within efforts to enhance smallholder access to credit and other critical production resources, livelihoods diversification, institutional strengthening at local to regional levels to support agriculture and strong gender oriented policy support.		22.3.4.1, 22.4.5.2, 22.4.5.4, 22.4.5.6, 22.4.5.7, 22.4.6	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low – Medium – Very high
Adverse effects on livestock linked to temperature rise and precipitation changes that lead to increased heat and water stress, and shifts in the range of pests and diseases, with adverse impacts on pastoral livelihoods and rural poverty (*medium confidence*)	Addressing nonclimate stressors facing pastoralists, including policy and governance features that perpetuate their marginalization, is critical for reducing vulnerability. Natural resource-based strategies such as reducing drought risk to pastoral livelihoods through use of forest goods and services hold potential, provided sufficient attention is paid to forest conservation and sustainable management.		22.3.4.2, 22.4.5.2, 22.4.5.6, 22.4.5.8	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low – Medium – Very high
Changes in the incidence and geographic range of vector- and water-borne diseases due to changes in the mean and variability of temperature and precipitation, particularly along the edges of their distribution (*medium confidence*)	Achieving development goals, particularly improvement in access to safe water and improved sanitation, along with enhancement of public health functions, such as surveillance. Specific adaptation options include vulnerability mapping and early warning systems. Coordination activities with other sectors.		22.3.5, 22.3.5.2	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low – Medium – Very high
Undernutrition, with its potential for life-long impacts on health and development and its associated increase in vulnerability to malaria and diarrheal diseases, can result from changing crop yields, migration due to weather and climate extremes, and other factors (*medium confidence*)	Early warning systems and vulnerability mapping (for targeted interventions); diet diversification; coordination with food and Agriculture sectors; improved public health functions to address underlying diseases.		22.3.5.2	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low – Medium – Very high

Climatic drivers of impacts

Warming trend | Extreme temperature | Precipitation | Extreme precipitation | Damaging cyclone | Sea level | Ocean acidification | Sea surface temperature

Risk & potential for adaptation

Potential for adaptation to reduce risk

Risk level with **high** adaptation

Risk level with **current** adaptation

Institutions that regulate access to and control of natural resources do not simply appear; they evolve over time [iii]

Lake Chad Basin

Current Status

On February, 2014 the collegial experts of the Lake Chad Basin Commission (LCBC) convened in N'djamena, Chad for the purpose of, "better understanding the human and environmental dynamics of the Lake Chad Basin."[iv] According to statements made by the Executive Secretary of the LCBC, Engr.

Sanusi Imran Abdullahi, the current status of the Lake Chad Basin (LCB) is, "A basin whose population is expected to double within the next twenty years and to urbanize, the production of more food and sustainable economic activities constitute serious challenges which the Lake Chad and its natural resources could contribute in meeting them. For the sustenance of the Lake Chad and its vast natural resources, the *interbasin water transfer project* remains the main solution or else the Lake Chad may meet the fate of the Aral Sea. The disappearance of Lake Chad will, therefore, be an ecological disaster, not only for the Member States of the LCBC but also for the whole world, for this environmental and humanitarian disaster will have no limit. By all criteria of assessment I will not hesitate to say that there is an emergency in the Lake Chad and the Lake Chad basin that needs to be addressed holistically in a sustainable manner and soon.

Note: The inter-basin water transfer project involves transferring an inflow of water coming from the Congo basin aimed at gradually restoring the normal ecological level in Lake Chad. A 28 month environmental impact assessment on the impact of such a transfer from the Congo to Lake Chad was initiated in October 2009 (end 2012). No current assessment on the implementation activities of the study are available.

Background

Once one of the largest water bodies in Africa[v], Lake Chad is slowly disappearing due to a variety of factors including climate change and overuse of water resources. Other contributing factors to the Lake's depleting water resources are a poor implementation record of environmental legislation and a lack of institutional capacity for effective water resource management.

The lake's water level and size has shrunk a massive 90% compared with what it was in the 1960s while its surface area has decreased from a peak of 25,000 square kilometers to approximately 1,350 sq.km today.[vi] Researchers Foley and Coe have determined the causes of the shrinkage as a mixture of climatic change and human activities.[vii]

The Lake Chad Basin Commission (members: Cameroon, Chad, the Central African Republic, Libya, Niger, Nigeria) has as one of its mandates, among others, to examine complaints and promote dispute settlement among Commission member-states. However, the Commission did not succeed in settling a number of conflicts and armed clashes which arose in the 1980s until the mid 1990s, between Nigeria and Cameroon. In retrospect, this calls into question the 'tool set' available to the Commission for managing the Lake's water resources, for managing outbreaks of conflict critical to the region's 22 million people who directly depend on these water resources.

The population growth rate across the region has ranged between 2.5%-3.0% per year on average over the past decades placing additional stress on Lake Chad's water resources. Between 1960 and 2012, the basin population has nearly quadrupled from 13 million to 46 million in 2012 according to the Lake Chad Commission.[viii] Further the basin's population is expected to double within the next twenty years and to urbanize.[ix]

Analytical methodology

One methodological approach for analyzing multidimensional security threats in the Lake Chad Basin, and in other case studies for that matter, is the Homer-Dixon environmental security model. [x] The model poses four steps or stages of analysis. These are summarized as follows:

1. To identify the damage of/to an ecosystem
2. To identify the harmful socio-economic effects resulting from environmental degradation
3. To identify other political, economic and social contextual conflict-aggravating factors
4. To analyze resulting conflicts (if any)

Applied to Lake Chad Basin (LCB) these stages are rendered as:

1. Eco-system damage: Severe water depletion due to anthropogenic and naturogenic casual factors, loss of fish (species) and natural habitat suitable for grazing, reduction in arable land suitable for agricultural production
2. Socio-economic effects: (baseline) fishing, livestock rearing and farming are the main economic activities of the region. Due to steadily declining water availability, collapsed fisheries, loss of livestock, crop failures have severely threatened the livelihoods of many living in the LCB
3. Further conflict-aggravating factors: Increased migration both into the lakebed or inland in search of arable land, significant loss of economic output across key (identified) sectors, resulting hardships may increase the risk of social segmentation and interethnic clashes between the numerous different ethnicities living around Lake Chad (e.g. the Nigerian section of the LCB is said to include 150 ethnic groups alone). Ecosystem degradation has, for example, led to clashes between itinerate herders and sedentary farmers Coupled with the loss of livelihoods, loss of income, increased water and food-scarcity (stress) is the fact that countries across the region have a (collective) legacy of inter-and-intrastate conflict.
4. Conflicts in the LCB have been registered between the following groups:
    a. Between upstream and downstream riparian users
    b. Competition over fish stocks between competing groups in the LCB
    c. Between nomadic herders/farmers (noted)
    d. Transborder migration of groups following the dwindling lakebed

A Word on the Lake Chad Basin Commission (LCBC)

The LCBC is the oldest of Africa's water commissions. Given this institution's long history (founded in 1964) and the equally long history of the deterioration of the lake's basin, lessons can and will be learned about the effectiveness and limitations of the LCBC and the implications for other water commissions, and the challenges they face, across Africa. Clearly the human and environmental security challenges in the LCB are myriad in their complexity; therefore disaggregating these complexities during this workshop's discovery process of the LCB becomes instructional for modeling robust and resilient solutions for application in other geographies. Institutional failures are equally instructional for avoiding

replicating similar policy failures ranging from a lack of sufficient institutional capacities to failures attributable to access to sufficient resources in other jurisdictions.

Questions for discussion

In conclusion at least three (3) relevant questions should be addressed during the Lake Chad session.

1. To what extent could more robust, coordinated, and informed policy choices have stemmed the slow and steady decline of water resources in the LCB?
2. What is the present and projected future trajectory of water access and availability in the LCB with a view particularly on its impact on human security?
3. What lessons can be learned from the long history of the LCBC in terms of creating more robust and resilient institutions better capable of responding to environmental or climate induced change in the LCB and in other regions?

Blue Nile

Nile System (Upper Nile Overview)

Current Status

The ongoing construction of the Grand Renaissance Dam (GERD) on the upper Nile (Blue Nile) is but the most visible apparition of more significant changes among the basin's states: Ethiopia, Egypt and Sudan. The GERD is now 30% complete and according to Egyptian authorities will begin to generate 775 MW of electricity by the end of 2014 and ultimately 6,000 MW when completed (projected end 2016). This hydroelectric project has both up-and-downside potential for both Ethiopia as well as for downstream Sudan and Egypt. On the upside, the dam will provide power where heretofore there has been none and should catalyze along with the electricity it produces an economic renaissance beginning in Ethiopia but with regional implications as far afield as the DRC. On the downside, Sudanese and Egyptian authorities argue they have not been sufficiently consulted either on the design of the GERD or on the projected impacts of the dam's construction (both short term in filling the dam's 74 bcm reservoir or longer term-in the absence of an agreement between all three states-on guaranteed future water quantities).

As stated, the GERD and by implication water are but indicative of greater changes occurring across this region. These other factors include:

- The impact of the climate (either cyclical naturogenic or anthropogenic-caused change resulting in drought) and the reservoir's impact on water availability (due to evaporation rates and diverted water for irrigation and power purposes) to downstream riparians Sudan and Egypt. As researchers Femia and Werrell point out, "Historically, water-sharing agreements often have

been based on the divvying up of the average annual river flows. Climate change reduces the reliability of this method. Historical flows no longer are acceptable indicators of future flows. Seasonal rain patterns are shifting. Seasons themselves are shifting.[xi]

- A historical shift in relative state-power away from formally dominant Egypt (due to uncertainty and ongoing cascading instabilities due to Egypt's own Arab Spring) and a pre-occupied Sudan (due to its own domestic instabilities as well as shared border problems with the emergent South Sudanese state). It is worth noting that historically strong ties between Egypt and Sudan may be joined in the near future by stronger ties between Ethiopia and Sudan due at least in part to Sudan accessing Ethiopian electricity and potentially more water for irrigation. In fact power distribution across the region should not be viewed in zero-sum terms but in fact, as evidenced by closer Sudanese-Ethiopian ties, could also be a positive game-changer in drawing both up-and-downstream countries closer together through an electricity grid with its Ethiopian generating hub but which could be extended in all directions.
- The impact of the costs of the dam (and others also under construction) and that of other related infrastructure construction on the availability of borrowing in the Ethiopian economy. In brief, there is the fear that Ethiopia's public expenditure for dam construction (which is self-financed at $4 billion equivalent to 12% of Ethiopian GDP) is crowding out other private investment. This is due to a state requirement that 27% of the private banking sector's loan portfolio must go to the state at an effectively subsidized interest rate making the cost of borrowing and the ability to borrow more difficult for lending purposes. In fact the Ethiopian economy did experience a 1% fall in its growth rate in 2013 over its 2012-2013 8.5% growth rate but it is inconclusive whether this can be directly linked to the crowding out of other investment-tied economic growth due to GERD and other dam construction in country.
- The water-food nexus also has a bearing on future water availability for the concerned states. According to researchers Francesco Femia and Caitlin E. Werrell (2011)[xii] they've pointed out that agriculture already requires a significant portion of total water demand within the Nile basin (as it does elsewhere globally) and makes up a considerable portion of the economic activity of upstream states. "These needs are far from stable. East Africa faced its worst drought in 60 years [in 2007] and Somalis facing potential famine fled into Kenya and Ethiopia. On top of this, countries such as China, Saudi Arabia and South Korea, have leased land in Ethiopia and Sudan, to produce crops for export. This will reduce the total amount of water available for other basin needs, and may lead to the export of "virtual water," or the water embedded in crops from water-rich lands of the Nile to water-poor countries abroad. Most *importantly this will impact the total water budget for the basin.*

Background

The Nile basin is currently composed of 11 states, including South Sudan, that share the waters of the longest river in the world. Historically, the division of the Nile's waters was controlled by Egypt and Sudan, as a result of an initial 1929 and then a 1959 colonial-era agreement. Through a combination of military and economic strength, the two hydro-powers have maintained access to a significant majority of the Nile's flow even though the river passes through all other upstream basin states first.

On 22nd February 1999 Ministers in charge of water affairs in the Nile Basin countries signed on to create a transitional institution called the Nile Basin Initiative (NBI). The NBI comprises the states of Burundi, DR Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania and Uganda. Eritrea participates as an observer.

The NBI provides riparian countries with the only all- inclusive regional platform for multi stakeholder dialogue, information sharing as well as joint planning and management of water and related resources in the basin. Water development has been funded through a Nile Basin Trust Fund (created 2003). The fund is arriving at its cyclical end (2014) and there is uncertainty if it will be replenished for future years by the international donor community.

In May of 2010, five upstream states signed a Cooperative Framework Agreement (CFA) to redistribute the waters more equitably across the basin. In March 2011, Burundi was the sixth signatory to the agreement, joining Ethiopia, Uganda, Rwanda, Tanzania, and Kenya to bring the agreement to a so-called "magic number." The agreement entered into force in May 2011, without the participation of Egypt, Sudan or the DRC (though the latter is expected to follow suit).[xiii] The fact that the former dominant riparian Blue Nile countries (Sudan and Egypt) have not yet signed onto the CFA is indicative of the shift in state power in the region towards Ethiopia. It is also indicative of their unhappiness with the CFA itself. Procedurally, once the CFA is signed (by all parties?) the NBI will be replaced by a Nile Basin Commission as a permanent institution.

A few other salient factors in the Blue Nile Basin for consideration are:

- An estimated 160 million people in the basin depend on the Nile for their livelihood.
- The annual discharges of the Nile system have decreased during the past two decades. It is postulated that rainfall over the Ethiopian Highlands will decrease by about 15 per cent, which would result in a 30 per cent decrease in the discharge of the Ethiopian tributaries of the Nile. [xiv]
- The main focus of Ethiopia's water development activities on the headwaters of the Nile seems to be on building dams, mainly for generating hydroelectric power to cope with the rapidly increasing demand for electricity for industrial and domestic purposes.
- The downstream states of Egypt and Sudan are heavily dependent on irrigated agriculture for food and cotton production, and use 94 per cent of the available Nile water. Agricultural use of irrigated water is expanding by bringing new land under cultivation. It is worth noting that over the period 2001-2011 agricultural trade in the Nile Basin increased by a factor of 600% indicating that opportunities exist for enhanced regional trade on a cooperative basis.

Questions for Discussion

1. What is the full scope of hydropower development across the region and what importance does and will this have on power dynamics on a regional basis?
2. Can the benefits of power availability, and how it is used for economic (principally agricultural) development contribute to more and not less cooperation among the region's states?

3. What are the anticipated impacts, from climate and water-related causal factors, on human security (as measured by changes in the human development index for example)? How will these impacts be spatially distributed in both positive and negative terms?
4. To what extent does the African Union's Continental Early Warning System (CEWS), headquartered in Addis Ababa, track climate and environmental related developments for impact on human populations? Is there a need for further resources, a broadened network of supporting institutions, or other steps for additional capacity building to assist the CEWS?

The Congo Basin

Current Assessment

Geographically the Congo Basin (CB) is comprised of 10 countries: Angola, Burundi, Cameroon, Congo, Gabon, the Central African Republic, the Democratic Republic of Congo, Rwanda, Tanzania, and Zambia.[xv] Because two-thirds of the CB are found in the DRC analysts routinely focus on both DRC domestic and DRC transboundry challenges to the basin. Obviously such an analysis needs to be expanded to account for regional impacts on water issues in the basin and how they may provide opportunities for cooperation and regional engagement where water issues and non-DRC specific challenges and developments coincide.

Having said this, there is no single cause of conflict in the DRC. The conflict in Congo is a complex web of inter-connected needs, interests, and grievances that exist not only domestically in Congo, but also externally in neighboring states, such as Rwanda and Uganda, that have historically been involved in influencing Congolese politics, economics, and national security to protect their own perceived interests in the region.

The primary drivers of conflict in Congo can be broken down into three over-arching categories: political, economic, and military. Politically, conflict is driven for consolidation of political power that allows for access to state resources and revenues--usually for personal profit. This conflict is driven between groups with various political, tribal and/or ethnic affiliations and is played out at local and national levels. Economically, conflict is driven by the government, rebel groups, and external actors for control over Congo's vast natural resource wealth, including some of the world's largest strategic mineral reserves. This conflict is played out primarily in Congo's eastern provinces and southern Katanga province. Militarily, conflict is driven due to the government's inability to extend complete control over its security services. Deep divisions within the military, as well as individual corruption and opportunism have created a national army that has been implicated in large-scale theft, extortion, human rights violations, and mutiny. This conflict is played out primarily in the east and in Kinshasa. As a sum of their parts, these various drivers of conflict have lead to chronic instability and conflict in Congo.[xvi]

Further, because of protracted conflict across the CB it is the river and not roads, either degraded due to conflict or in a poor (original) state, that provide the main infrastructure for transport across the region. Recent attention is however being paid to development of river crossings with a view to the Congo itself being a significant barrier to land based transport for trade purposes.

Current Climate Impact Assessment in the CB

According to a Climate Change assessment carried out between 2010-2013 entitled, "Climate Change Scenarios for the Congo Basin" by the Gesellschaft für internationale Zusammenarbeit (GIZ) GmbH, the Climate Service Centre (CSC) in Hamburg and the Wageningen University and Research Centre (WUR) in the Netherlands the following summary is provided with specific respect to temperature change, change in precipitation, and ultimately water availability.

For the near surface air temperature, all assessed models agree on a substantial warming [in the CB] towards the end of the century in all seasons of the year regardless of the underlying scenario. On an annual basis a warming in the range of +1.5 and +3°C for the low and in the range between +3.5 and +6°C for the high emission scenario can be considered to be likely towards the end of the 21st century. In general projected temperature increase is slightly above average in the northern parts of the region and slightly below average in the central parts. Also for temperature extremes (frequency of cold/hot days and nights) all models agree on a decrease/increase in the future. Especially the hot days and nights are projected to occur much more frequently in the future, particularly in the case of the high emission scenario. These changes can be considered to have a very large robustness.

For total precipitation the agreement between the assessed projections is not as high as for the temperature. For all zones some models project an *increase i*n annual total precipitation and some project a decrease. If the full range of projected changes in annual total precipitation is considered, all models agree on a change not higher than ±30% towards the end of the 21st century for most parts of the domain with a general tendency of a slight increase in future annual total precipitation. However, in the dryer northern part, a larger increase in annual total precipitation (full range up to about +75%) is projected, mainly related to the northward expansion of the tropical convection zone, which was already described in the scientific literature. These findings are independent of the underlying emission scenario. If only the likely range is considered, projected changes in annual total precipitation are between ~ -10 to +10% (-10 to +30% in the north) and between -5 to +10% (-10 to +15% in the north) for the high and low emission scenarios respectively. This finding once again points to the conclusion that - on the basis of the assessed large ensemble of climate change projections – it is not likely that drastic changes in annual total rainfall will occur in the future over the greater Congo basin region.

Although the annual total precipitation amounts might not change dramatically, the rainfall characteristics are projected to undergo some substantial changes. An example for this is the likely increase in the intensity of heavy rainfall events in the future (likely range for most parts positive, up to ~ +30%). Also the frequency of dry spells during the rainy season is projected to substantially increase in the future over most parts of the domain. This indicates a more sporadic rainfall distribution in the future.

In summary the climate change assessment for the greater Congo basin did reveal that projected rainfall changes are *unlikely to lead to a general water shortage in the region*, however some prolonged and more frequent dry periods might become more likely in the future.

Background

With a catchment area of more than three and a half million square kilometers, the Congo is the world's second largest river basin. Two-thirds of this area belong to the Democratic Republic of the Congo. The species-rich ecosystem of the Congo Basin is one of the last 'green lungs' on the Earth, and it is essential for global climate protection.[xvii]

Due to the enormous water resources it contains and its consistently high discharge at the river's mouth, the Congo Basin river system offers great potential for sustainable energy production, inland waterway transport, fisheries and agriculture. Its 25,000 km of navigable waterways still form the most important network for regional trade and transportation.

Some Additional Challenges:

- War and political instability have destroyed a significant amount of the river infrastructure. To put this in perspective, Sub-Saharan Africa was the most conflict ridden area in the world over 1990-2007 (accounting for 88 percent of conflict-related deaths worldwide). The International Rescue Committee estimates that 5.4 million people in the DRC have been killed by war or disease since 1998. The security or 'operating environment' incapacitates requisite inward foreign investment, which is readily acknowledged to be the major potential enabler of water and power development in the DRC and its region. Understanding the operating environment, beginning with the DRC on a sub-regional DRC intrastate basis, will provide water and energy practitioners a much better understanding of conflict drivers and dynamics in the country and its region. Again, this understanding will help outline strategies that could help mitigate violent competition for these (and other) resources and to promote economic development, power generation, and water management across central, eastern, and southern Africa.
- The lack of maintenance of waterways and navigational aids and insufficiently trained crews and port personnel lead to frequent shipping accidents.
- Illegal customs fees hinder regional trade.
- Lack of credible land based transport infrastructure further hinders regional trade

The International Commission of the Congo-Oubangui-Sangha Basin (CICOS)

Cross-border cooperation between the riparian states is essential if the great economic potential of the Congo Basin is to be harnessed while simultaneously protecting its natural resources. To this end, the International Commission of the Congo-Oubangui-Sangha Basin (CICOS) was founded in 1999 by the Republic of the Congo, the Democratic Republic of the Congo, the Central African Republic and the Republic of Cameroon. The mandate of CICOS includes all aspects of integrated water resource management with particular emphasis on inland shipping. The General Secretariat of CICOS and the Commission's training centre have been located in Kinshasa since 2004.The management of the Congo Basin is coordinated between the CICOS member countries in accordance with the specifications of the regional agreement governing inland waterways and transnational water resources management.

Since 2006, the project Gestion Transfrontalière de l'Eau dans le Bassin du Congo (GETRACO) has been supporting the establishment of the International Commission of the Congo-Oubangui-Sangha Basin (CICOS).

The role of CICOS as the regional river basin commission is supported through the following project activities:

- Capacity development of staff at the Secretariat and national partner institutions
- Promotion of good governance through integrated natural resource management
- Adoption of a single legislative framework (regulations governing the inland waterways), standardisation and harmonisation of regulations to promote a sustainable river transport sector

A number of dialogue processes have been initiated with all those involved, focusing primarily on the key issues of shipping safety, water safety, development adapted to climate change, socio-economic development and poverty reduction in the Congo Basin. For example, the process of dialogue to implement the Malebo Pool Convention seeks to improve cooperation between the governments of the two Congo states. This cooperation should shorten the journey time for goods and passengers between Brazzaville and Kinshasa. Together, the two cities already form Africa's third largest metropolitan area.

Socio-economic perspective on the impact of the lack of power in the DRC and the CB in general

The DRC desperately needs energy to grow. This mineral-rich expanse the size of Western Europe is Africa's fourth most populous country but also one of its poorest. The International Monetary Fund estimates the DRC's gross domestic product per capita at $171 – placing it last among the 180 countries studied last year. That's lower in real terms than when the DRC threw off colonial rule by Belgium in 1960. In addition to myriad social and political challenges, economic growth is thwarted by a dearth of reliable electricity. The DRC's mining-rich eastern Katanga province and Kinshasa province already suffer a net shortfall of 1,400 megawatts that holds back growth.

Inadequate access to energy is the single largest impediment to economic growth across Africa according to a World Bank study released in November (2009), Africa's Infrastructure: A Time for Transformation. As the report notes, the generation capacity of the 48 countries of sub-Saharan Africa is equivalent to that of Spain, which has one-twentieth the population. In all, inadequate electricity, water, roads and communications systems cut economic growth every year by 2 percentage points across sub-Saharan Africa. Of the $93 billion investment in infrastructure needed annually over the next decade, almost half is needed to address the continent's power supply crisis. And the DRC's investment shortfall is particularly severe. The state power utility, the Société Nationale d'Électricité (SNEL), delivers electricity to just 7% of the DRC's 68 million people.[xviii]

Unrealized regional ties and transboundry cooperation

The DRC is a member of the Southern Africa Development Community (SADC) which provides common principles for cooperation in terms of power pooling and transboundary water management and development. However, being on the periphery of this market space and ridden by internal tensions and conflicts the potential to develop its major hydropower resources are not yet realized for the benefit of Congo, SADC and Sub-Saharan Africa on the whole. There is no basin-wide agreement between the riparian countries on the Congo basin on its management and development which according to customary international water law can be a significant impediment to development of its hydropower resources.

Perhaps in no other region of the world are the opportunities greater for transboundary cooperation in terms of water and energy and the risks more pronounced for a larger segment of the population than in the DRC . Sub-Saharan Africa has 63 transboundary river basins that account for 93% of Africa's water resources. These river basins have a major development potential in terms of water for energy production, primary services, industry and domestic use and the preservation of ecosystem goods and services. The power markets are in most cases domestic, poorly developed and isolated with access to electricity standing at about 10% (again 7% in the DRC). The price for power for the consumers is very high due to poor energy supply chains and dependence on fossil fuels that needs to be transported across large areas. To reach development objectives cooperation is necessary between the countries considering the flow of the water resources across borders and the need to sell power to existing consumers and develop new markets through the right incentives (centralized and decentralized). Fortunately, real markets for goods in the DRC and region do exist but these markets have not benefited from the larger trade in water and power goods and services.

Questions for Discussion

1. How do political, economic, and governance factors outside of the DRC affect water and development in the CB? Are there positive cooperative exchanges that may provide a model for future cooperative engagement transferable to water?
2. Unlike in other riparian regions in Africa, the CB appears to suffer less than others from projected water scarcity. It is acknowledged that climate change impact is not spatially and evenly distributed, therefore are there potential hotspots (drought, floods) that can be identified that may emerge in the future in the CB?
3. What are the prospects for substantially increasing inward foreign investment for power and other industrial purposes in the CB if conflict continues to persist?

The Lake Victoria Basin

Background

The Lake Victoria basin is located in the central region of East Africa and covers an area of 251 000 km^2 of which 7.2% is in Burundi, 21.5% in Kenya, 11.4% in Rwanda, 44% in Tanzania and 15.9% in Uganda (Figure hereunder). Lake Victoria is the second largest lake in the world with an area of 68,800 km^2 and a number of satellite lakes and rivers. The main lake and satellite lakes are fringed by extensive wetlands. About 35 million people (about 30% of the East African population) are estimated to live and derive their livelihood directly or indirectly from the basin. (LVBC 2014[xix])

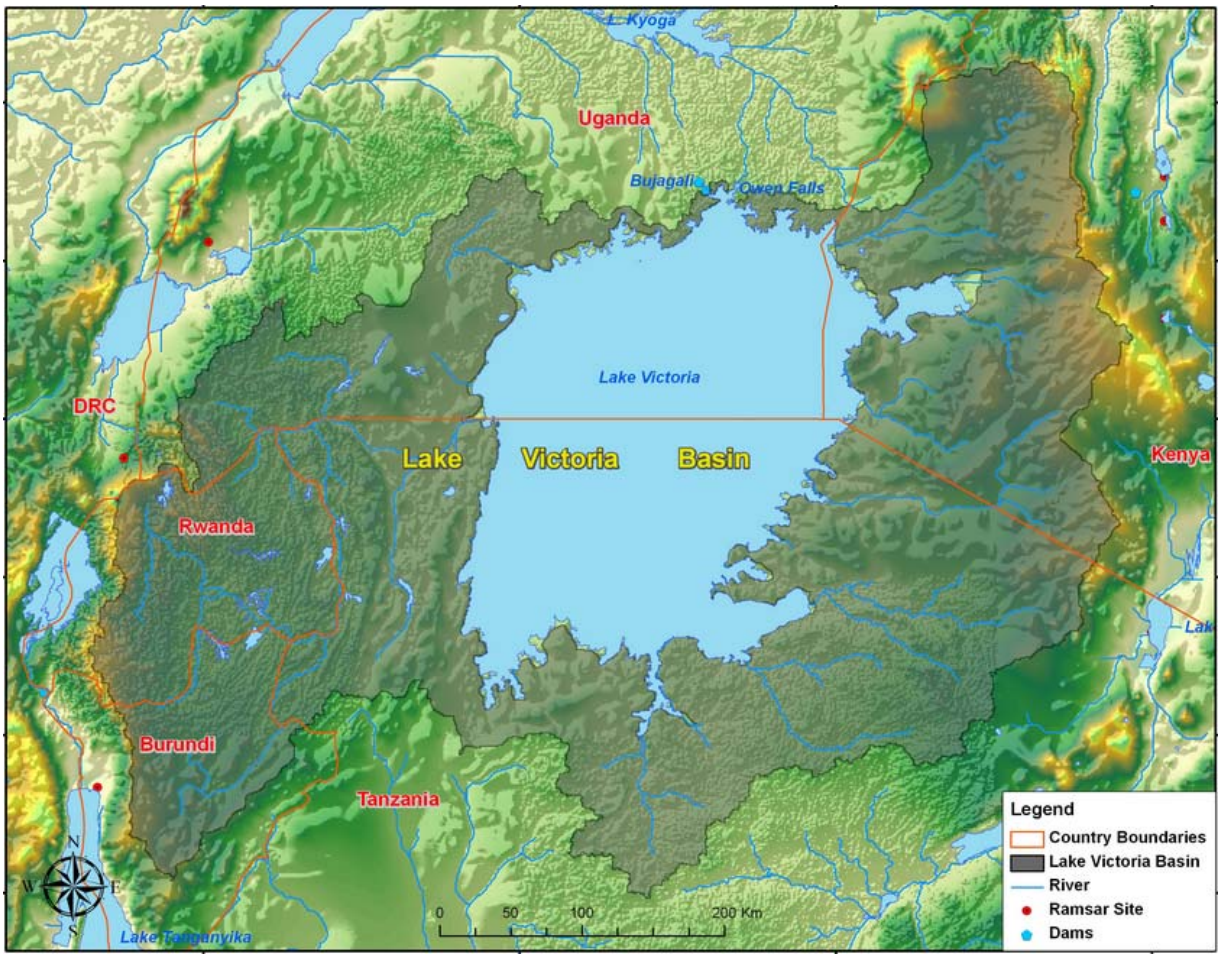

Figure: Lake Victoria basin, indicating the basin boundary and country boundaries (UNEP, 2014[xx]).

The Basin provides good conditions for agriculture, fishing and other economic activities, which supports one of the densest rural populations in the world (up to 1 200 people/km^2 in parts of Kenya). The people of Lake Victoria Basin are involved in several activities in support of their livelihoods including fishing, farming, bee keeping, trading activities, quarrying and mining, with the perceptions and practices

related to the exploitation of the natural resources being closely intertwined with livelihoods and culture. The forest and woodland resources have changed rapidly due to population increase, commercialization of timber, unsustainable agricultural practices, increased energy demand, terrestrial invasive species and lack of appropriate technologies for forests and woodland conservation. The freshwater resources are affected by water quality and quantity concerns, waterborne diseases and transboundary water management issues. The basin is characterized by low investment in technology and the exploration and assessment of freshwater potential, The lake receives factory effluent and sewage from the surrounding urban centres, with most factories in Kisumu, Jinja, Kampala and Mwanza not having waste water treatment facilities. The amount of pollutants has far exceeded the assimilative capacity of the lake, leading to an organic pollution load that supports the rapid growth of water hyacinth. (UNEP 2006[xxi])

Opportunities and Challenges

The basin and associated rivers have a large hydropower potential and also holds biomass, petroleum and renewable sources of energy. Biomass energy sources are classified into traditional biomass energy (firewood, charcoal and agricultural residue) and modern biomass energy (ethanol, biodiesel and biogas). Traditional biomass energy support livelihoods for the populations in rural and urban areas. (UNEP 2006)

Opportunities for development include water, fish, minerals and agriculture, while the land offers vast resources to support development goals. Conservation of the forest reserves in the basin provides opportunities for biodiversity conservation and economic returns through ecotourism. Freshwater fisheries contribute significantly to export earnings with annual fish yields in excess of 500 000 tonnes worth US$600 million annually. Renewable energy sources can be harnessed in the long term to meet a significant portion of the basin countries energy needs without impairing the ecosystem, which includes hydropower. (UNEP 2006)

The emerging trends include population growth and corresponding increases in the demand for energy and other resources in the basin. This will require good decision-making to maintain and improve the quality of human life by reducing the vulnerability of the basin population to these issues (improving resilience). Resources use conflicts, the impact of global trade on resource use and emergence and re-emergence of diseases are further challenges to future development. (UNEP 2006)

Questions for Discussion

1. How can natural resources effectively be developed and used to support development objectives?
2. Are there institutional constraints to development in the basin?
3. How does regional political stability and security affect human security in the basin?
4. What are the options for adaptation to climate change to reduce vulnerability and increase human security?

[i] IPCC, 2013a: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

[ii] IPCC, 2013b: Climate Change 2013: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[iii] IJCV : Vol. 5 (1) 2011, pp. 155 – 172 Mildner, Wodni, and Lauster: Scarcity and Abundance Revisited:161

[iv] Presentation of the collegial expertise - FFEM project, see: http://www.cblt.org/en/presentation-collegial-expertise-ffem-project, 24 February 2014

[v] It was once the largest water reservoir in sub-Saharan Africa.

[vi] World Bank, "Restoring a Disappearing Giant: Lake Chad," March 27, 2014: http://www.worldbank.org/en/news/feature/2014/03/27/restoring-a-disappearing-giant-lake-chad.

[vii] Coe, Michael; Foley, Jonathan (2001): Human and natural impacts on the water resources of the Lake Chad basin. In: Journal of Geophysical Research. Vol. 105, No. D4, p. 3349 – 3356. Cited in *www.nai.uu.se/ecas-4/panels/21.../Metz-**War**ner-Brzoska-Full-paper.pdf*. Environmental degradation in the region has been described as follows (ibid. Metz-Warner-Brzaska): Back-to-back droughts in the 1970s and 1980s and missing rains led to desertification of the region with the Sahara moving more than 100 km south. As people could not rely anymore on monsoon water, they became more and more dependent on the lake. Thus irrigation projects and the construction of dams significantly reduced water from both, the lake and the two main rivers that drain into Lake Chad, the Logone and Chari River, and hastened the shrinkage. At the same time, the vegetation needed for grazing livestock began to disappear because of the ongoing desertification and overgrazing. A domino effect began: Depleted vegetation reduced the ecosystem's ability to recycle moisture back into the atmosphere. This, in turn, contributed to reduced monsoon rainfalls and increased dependence on the lake's water. In addition, the loss of canopy cover led to soil erosion and loss of soil fertility.

[viii] See Lake Chad Basin Commission, http://www.cblt.org/en/lake-chad-basin

[ix] Comments made by Executive Secretary of the LCBC, Engr. SANUSI IMRAN ABDULLAHI. HOLDING IN N'DJAMENA – CHAD 24th February 2014, see: http://www.cblt.org/en/presentation-collegial-expertise-ffem-project

[x] Homer-Dixon (1999): Environment, Scarcity, and Violence. Princeton University Press, Princeton – Oxford

[xi] Femia, [xi] Francesco and Werrel, Caitlin E. "The Nile Basin: Preventing Water Conflict" The Center for Climate and Security, Washington, D.C., 20 July 2011

[xii] ibid

[xiii] ibid

[xiv] Bitsue, Kidan Kiros, "The Nile: From Mistrust and Sabre Rattling to Rapprochement," Institute for Security Studies Paper, No.238, Pretoria, South Africa

[xv] http://www.cicos.info/siteweb/index.php?id=301

[xvi] Pendergast, John,"What is the Main Cause of Conflict in the Democratic Republic of Congo," Huffington Post, 1 May 2014, see: http://www.huffingtonpost.com/quora/what-is-the-main-cause-of_b_5133945.html

[xvii] 'Transborder water management in the Congo Basin'Deutsche Gelleschaft fuer Zussamarbeit, see: http://www.giz.de/en/worldwide/14933.html

[xviii] Rosner, Kevin and Granit, Jakob, "Promoting Post-Conflict Conflict Stability and Development in the Democratic Republic of Congo (DRC): Focus on the Water-Energy-Security (WES) Nexus, Proposal Submission to the US Institute of Peace, May 2013

[xix] http://www.lvbcom.org/

[xx] http://gridnairobi.unep.org/Portal/

[xxi] UNEP, 2006. Lake Victoria Basin Environment Outlook: Environment and Development. UNEP, Nairobi.